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POLLUTION SURVEY OF MINTERS CREEK AND THE BLACK WARRIOR RIVER IN THE VICINITY OF EUTAW, ALABAMA

Robert A. Taft Sanitary Engineering Center
Cincinnati, Ohio

September 1957

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U. S. Department of Health, Education, and Welfare
Public Health Service
Robert A. Taft Sanitary Engineering Center
Cincinnati, Ohio

September 1957

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CONCLUSIONS

1. The pollution load from Eutaw's sewage had little effect on the Black Warrior River under survey conditions.

2. The pollution load from Eutaw's sewage will probably have even less effect on the main body of the Black Warrior River after the closure is made for the new lock and dam downstream from Eutaw.

3. A new outfall constructed near manhole 10 for the purpose of discharging untreated sewage into the Minters Creek Embayment would be undesirable if the Minters Creek area is to be used for recreation.

4. Treatment of raw sewage should be considered if the Minters Creek Embayment is to be used as a recreational area.

POLLUTION SURVEY OF MINTERS CREEK AND THE BLACK WARRIOR RIVER IN THE VICINITY OF EUTAW, ALABAMA

INTRODUCTION

Under date of April 5, 1957, the District Engineer, Mobile District, Corps of Engineers, requested the services of the Robert A. Taft Sanitary Engineering Center, U. S. Public Health Service, to make a survey of present conditions in the vicinity of the town of Eutaw, Alabama, as related to the existing sanitary sewer outfall and the receiving streams, Minters Creek and the Black Warrior River. In response to that request, field operations were initiated June 10, 1957.

The specific purposes of the study were as follows:

1. To determine the composition, strength, and quantity of sewage discharged to Minters Creek and to the Black Warrior River, from the town of Eutaw, Alabama.

2. To determine the quality and quantity of present flow in Minters Creek and in the Black Warrior River.

3. To determine the amount of reduction, if any, in strength and composition of the sewage which occurs in Minters Creek.

4. To determine the effect of sewage in Minters Creek on the Black Warrior River.

5. To determine the quantity of suspended solids discharged to the Black Warrior attributable to sewage discharged from the town of Eutaw, Alabama.

6. To predict the effect of the continued discharge of sewage into the proposed embayment.

7. To determine alternate locations for the outfall sewer.

The survey was accomplished by a field crew of three engineers, two chemists, one scientific aide, and local hired labor working from a mobile laboratory set up in Eutaw, Alabama. Scientific personnel were from the Region IV office, Public Health Service, and from the Robert A. Taft Sanitary Engineering Center, Public Health Service.

The final report was prepared jointly by Region IV and Robert A. Taft Sanitary Engineering Center personnel.

The survey was aided materially by the town of Eutaw, Alabama and the Alabama State Department of Health. The cooperation furnished by the town of Eutaw and the Department of Health is gratefully acknowledged.

DESCRIPTION

The town of Eutaw, Greene County, Alabama, is located on a ridge between Minters Creek and Watson Creek. The town had a population of 2,348 according to the 1950 census. There is no major industry located in the village. The town is not completely sewered.

The present sewerage consists of one main sewer line which collects sewage from 262 sewered residences and about 800 people. The main sewer is located in the drainage area of Minters Creek. A lift station delivers some sewage to the main sewer from the Watson Creek drainage area. The ridge separating the drainage areas is about forty to fifty feet high. The underlying stratum was reported to be limestone.

The sewage from Eutaw is discharged untreated into Minters Creek through a 10" V.C. outfall sewer about 11,000 feet in length. There is a break in the sewer line about 1,900 feet from Minters Creek, permitting the sewage to be discharged into a small unnamed tributary to Minters Creek. The raw sewage then flows in the small branch and discharges into Minters Creek. The unnamed branch is normally dry; there is, of course, a small wet-weather flow. Minters Creek meanders for about two miles before discharging into the Black Warrior River.

Minters Creek originates in the Northeast portion of Greene County above Salem Church and flows in a southerly direction for about twelve miles to its confluence with the Black Warrior River. It drains a combination of agricultural and forested areas. The stream varies considerably in width, and is usually one to three feet in depth through

its course, with occasional pools, some of which are five feet or more in depth. The area through which the polluted waters of Minters Creek flow is densely wooded and is remote from human habitation. At the present time, it is difficult to get into that area due to lack of roads. The principal land uses in the polluted area appear to be logging and hunting.

The Black Warrior River is canalized from its mouth to the vicinity of Birmingham, Alabama, by nine low-lift locks and two high-lift locks. The entire flow of the river is regulated for navigation, particularly during the summer and fall months.

The Black Warrior River Basin is the most highly industrialized basin in the State of Alabama. Coal and iron ore mining, steel production, processing of steel products, chemical by-products associated with the production of pig iron, chemicals, paper making, oil refining, and wood preserving comprise the major industries. The area of the basin for the portion of the river surveyed is largely agricultural with dairying and beef cattle production the major agricultural interests in Greene County. In addition to barge traffic, the river near Eutaw is used for fishing and recreational boating.

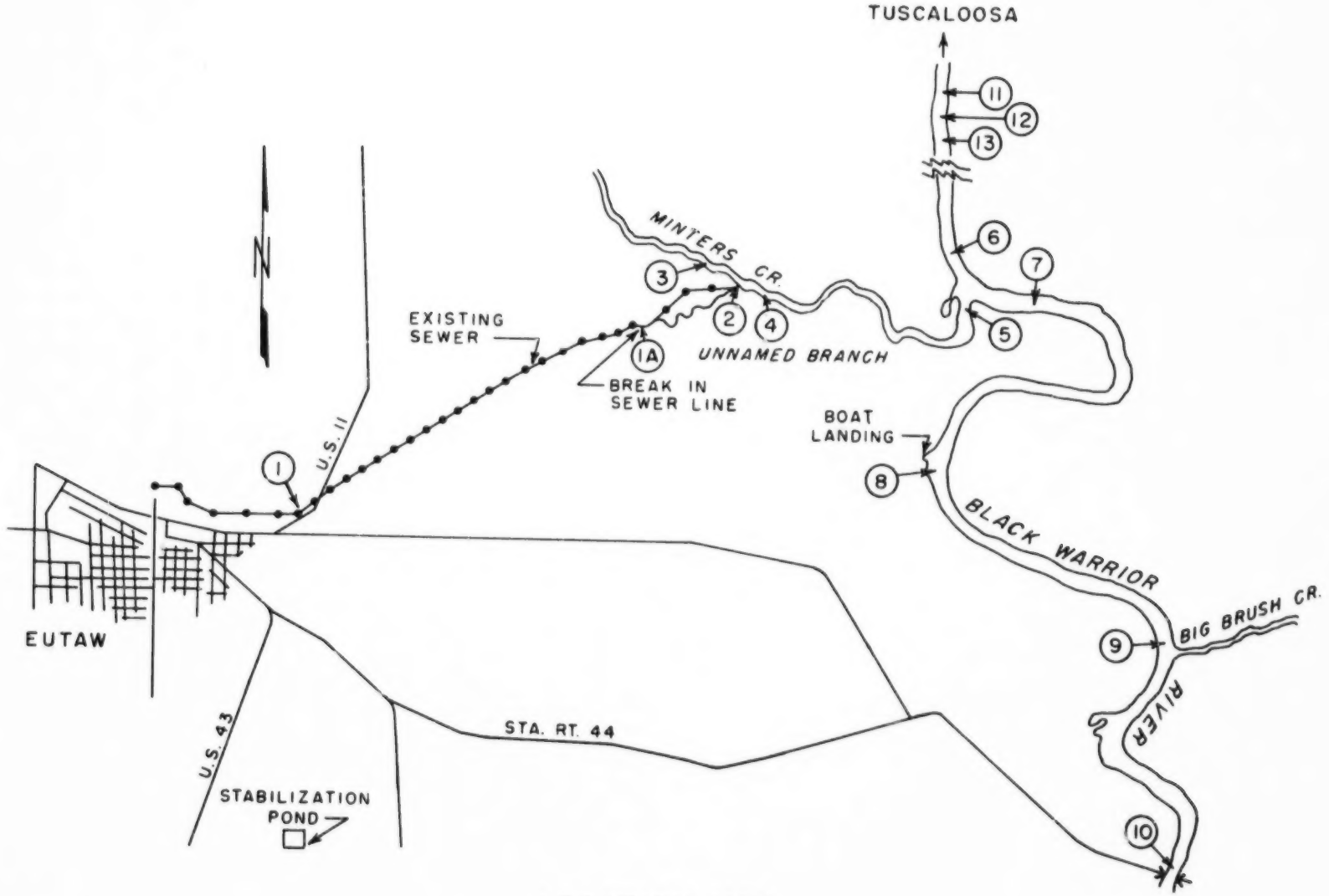
SURVEY METHODS, PROCEDURES, AND DATA

The primary objectives of the field study were the collection of stream quality data, information on magnitude of pollution load, and stream flow data for the purpose of determining the present degree of pollution in Minters Creek and in the Black Warrior. Field operations were started on June 17 and continued through June 27, 1957.

Fourteen sampling stations were selected, two on raw sewage, one on raw sewage and run-off, three on Minters Creek, and seven on the Black Warrior River. These stations are shown in Figure 1 and are described briefly in Table 1.

Sampling at all stations except 2 and 4 consisted of single grab samples or composites of multiple grab samples taken at intervals during the day. At Stations 2 and 4, sampling consisted initially of composites of grab samples and later, starting on June 21, composites were collected by vacuum over a 7-hour period during the day or night. All sampling was performed during the period June 17 through June 27, though samples were not taken on all of the days during that period.

Time of flow of sewage from Eubaw to the break in the sewer line, and time of flow of sewage and run-off in the unnamed branch from the sewer line break to Minters Creek were determined by the use of fluoroscein dye. Dye placed in the sewer line at Station 1 required 2½ hours to reach the break in the sewer line, a distance of about 8,000 feet. The velocity was determined to be about 1½ feet per second. Dye placed in unnamed branch at the sewer break required 2 hours



LOCATION MAP
SAMPLING STATIONS AND STABILIZATION PONDS
EUTAW, ALABAMA
FIGURE 1

TABLE 1

Eutaw, Alabama, Pollution Survey Sampling Stations

Station Designation	Stream	Distance From Confluence With Tombigbee River (1)	Description
1	Sewer Line	10,000'	Manhole at end of street which runs off Tuscaloosa highway at Means Funeral Home.
1A	Sewer line	1,930'	Break in sewer line where sewage discharges into small unnamed branch.
2	Unnamed Branch	10'	Just above V-notch weir in unnamed branch about 10' upstream from its confluence with Minters Creek.
3	Minters Creek	2.1 mi.	30' upstream from entrance of sewage.
4	Minters Creek	2.0 mi.	Just above the rectangular weir which was located 100 yds. downstream from entrance of sewage into Minters Creek.
5	Minters Creek (Confluence with Black Warrior River 62.5 mi.)	20'	In mouth of Minters Creek where it joins the Black Warrior River.
6	Black Warrior River	62.7 mi.	About $\frac{1}{4}$ mile upstream from entrance of Minters Creek.
7	Black Warrior River	62.2 mi.	About $\frac{1}{4}$ mile downstream from entrance of Minters Creek.

(1) Not applicable to Stations 1 through 5. See description.

TABLE 1 (Con't.)

Eutaw, Alabama, Pollution Survey Sampling Stations

Station Designation	Stream	Distance from Confluence with Tombigbee River	Description
8	Black Warrior River	60.5 mi.	At Eutaw boat landing 300 yds. downstream from Alabama Great Southern RR bridge. This point is about 2 miles downstream from entrance of Minters Creek.
9	Black Warrior River	59.5 mi.	About 3 miles downstream from Minters Creek and opposite the confluence of Big Brush Creek with the Black Warrior River.
10	Black Warrior River	58.5 mi.	At Highway 44 bridge which is about two miles below Eutaw boat landing and about four miles downstream from entrance of Minters Creek.
11	Black Warrior River	66.0 mi.	At Broadnax's Landing which is about 4½ miles upstream from entrance of Minters Creek. This station was not used during this particular survey.
12	Black Warrior River	83.0 mi.	At Lock No. 9 about 21.5 miles upstream from Minters Creek.
13	Black Warrior River	110.7 mi.	At boat landing about ¼ mile downstream from Fosters Ferry Bridge; about 49 miles upstream from Minters Creek.

0-7

50 minutes to travel the 1,900 feet to the V- notch weir, an average velocity of 0.2 feet per second. The time of flow from Station 2 to Station 4, a distance of 300 feet, was 15 minutes, for an average velocity of 0.3 feet per second. Dye placed in Minters Creek at Station 4 failed to appear at Station 5 within 7 hours, a distance of about 10,500 feet. The time of flow was not determined but apparently is less than 0.3 feet per second.

Quantity of flows was determined by a 90° V-notch weir at Station 2 and by a 6-foot sharp edge rectangular weir at Station 4. Staff gauges and continuous water level recorders were installed at Stations 2 and 4. Provisional flows for the Mack Warrior River were obtained from the Mobile District, Corps of Engineers. Hydrometric data is presented in Table 2.

Temperature, dissolved oxygen (D.O.), solids (total, total fixed, suspended, suspended fixed, and settleable), pH, alkalinity, color, 5-day 20°C biochemical oxygen demand (B.O.D.), and coliform organisms were determined on all Minters Creek samples. Solids, pH, and B.O.D. were determined on all samples of raw sewage from Station 1, and of mixed raw sewage and run-off at Station 2. Only solids determination were performed on samples of raw sewage from the break in the sewer line (Station 1A). Coliform organisms and dissolved oxygen were determined on Black Warrior River samples. The laboratory results obtained during the field survey have been tabulated and are presented in Tables 3 through 14.

Table 2

Hydrometric Data

Station 2			Station 4			Station 6	
Date	Time	Q CFS	Date	Time	Q CFS	Date	Q CFS
	(1)					(2)	
6-17	11:30A	.116	6-17	11 A	2.46	6-17	1480
				4 P	2.46	6-18	1340
6-19	8 A	.088				6-19	1310
	12 N	.125	6-19	Weir out		6-20	1010
	4 P	.324				6-21	1290
			6-20	9 A	1.64	6-22	1420
6-20	Weir out			11 A	1.64	6-23	1580
						6-24	2040
6-21	11:45A	.1086	6-21	8 A	1.64	6-25	3300
	4:40P	.1086		11 A	1.64	6-26	3250
	10A-4P	.1024		4 P	1.64		
6-22	8A-4P	.088	6-22	8A-4P	1.64		
6-23	4P-9A	.1006	6-23	4P-9A	1.64		
6-24	8A-4P	.165	6-24	9 A	12.7		
	8:35A	.140					
			6-25	8A-4P	4.26		
6-25	Weir out						
			6-26	4P-8A	4.20		
6-26	Weir out						

NOTE:

(1) Where one time is given, Q is discharge at that time; and where two times are given, 8A-4P for instance, Q is average discharge for that period.

(2) Flow in the Black Warrior River can be expected to be less than 300 CFS for ten continuous days or longer once per ten years.

Table 3

Tabulation of Individual Results
Sewage from Town of Eutaw, Alabama

Station	Date 1957	BOD (5-day, 20°C) ppm	Solids					pH
			Settle-able (ppm by volume)	Total ppm	Total Fixed ppm	Susp. ppm	Susp. Fixed ppm	
1	6-17	-	12,000	1,376	608	370	24	-
	6-19	217	-	1,216	796	178	38	7.2
	6-20	206	8,000	1,026	568	160	20	7.6
	6-21	185	12,000	1,042	571	245	26	7.5
	6-22	296	15,000	1,069	620	220	14	7.7
	6-23	173	-0-	902	562	136	14	7.1
	6-24	144	4,000	867	615	109	11	7.2
	6-25	184	10,000	973	578	189	17	7.7
1-A	6-18	-	7,000	1,164	712	288	58	-
	6-20	-	23,000	1,000	476	212	53	-
	6-21	-	12,000	908	546	247	55	-
	6-22	-	-	-	-	-	-	-
	6-23	-	-0-	514	383	32	10	-
	6-24	-	21,000	1,021	601	424	113	-
	6-25	-	10,000	678	451	91	25	-

Table 4

Tabulation of Individual Results and
Summaries of Results (Unnamed Branch)

Sta.	Date	Type of Sample	Time	Temp. (°C)	D. O. (ppm)	B.O.D. (ppm)	pH	Alk. Total (ppm)	Color (ppm)	*Coliform Organisms MPN/100 ml			Solids (ppm)				
										Left	Center	Right	Settle-able	Total	Total Fixed	Susp.	Susp. Fixed
2	6-17	Grab	11:30 A)	32													
		Grab	3:40 P)	30		152	8.0						1750	708	428	150	72
		Comp.															
	6-19	Comp.	(8-12-4)	--		43	7.7						--	658	492	62	32
	6-20	Grab	9:15 A)														
		Grab	11:30 A)	--		16	7.3						500	516	304	160	129
		Comp.															
	6-21	Grab	8:40 A)	--													
		Grab	11:45 A)	--		28.8	7.5						900	470	336	59	25
		Grab	4:40 P)	--													
		Comp.															
		**Comp.	(10A - 4P)	--		60	7.5						2000	566	317	66	35
	6-22	**Comp.		--		25	7.4						4000	627	467	160	85.5
	6-23	**Comp.	(4P - 9A)	--		24	7.3						Negative	602	415	44	8
	6-24	**Comp.	(8A - 4P)	--		5.5	7.4						Negative	470	383	37	11.5
		Grab	8:35 A)	--													
		Grab	8:35 A)														
		Comp.		--		41	7.0						5000	685	507	336	190
	6-25	**Comp.		--		14	7.3						100	594	444	18	11.5
	6-26	**Comp.		25		17	7.4						Negative	542	319	25.5	8.5
		(DO 7:30A)															
	6-27	**Comp.	(2:30P - 8A)	--		--	7.3						Negative	--	--	33	0
Average				29		38.7	--						1295	585.1	401.1	95.9	50.7
Maximum				30		152	8.0						5000	708	507	336	190
Minimum				25		14	7.0						Negative	470	304	18	0

** Continuous composite by vacuum

Table 5

Tabulation of Individual Results and
Summaries of Results (Minters Creek)

Sta.	Date	Type of Sample	Time	Temp. (°C)	D. O. (ppm)	B.O.D. (ppm)	pH	Alk. Total (ppm)	Color (ppm)	*Coliform Organisms MPN/100 ml Left	Center	Right	Solids (ppm) Settle-able	Total	Total Fixed	Susp.	Susp. Fixed
3	6-17	Grab	11:30 A)	32	8.7	3.0	7.8	47.0	33		3600			127	92	5.6	44
		Grab	3:30 P)	30	8.4												
		Comp.															
	6-19	Grab	9:30 A)	29	7.5	2.1	7.2	44.5	37		2300			158	120	20	9
		Grab	2:45 P)	32	11.4												
		Comp.															
	6-20	Grab	9:15 A)	28	8.6	1.4	7.5	45.5	33		4300			125	69	3.5	0
		Grab	11:30 A)	28	10.7												
		Comp.															
	6-21	Grab	8:30 A)	28	7.5												
		Grab	11:15 A)	31	11.2	1.6	8.0	52.5	33		750			138	62	9	2
		Grab	4:40 P)	32	10.2						230						
		Comp.															
	6-22	Comp.	DC 10 A	29	8.0	1.8	7.8	49.0	28		4300			101	86	18	12
	6-23	Grab	9:00 A	29	7.5	0.8	7.6	49.0	27		430			133	68	5.5	2
	6-25	Grab	9:00 A	28	7.8	0.9	7.5	22.0	32					78	75	--	16
	6-26	Grab	7:30 A	25	6.4	0.7	7.4	17.0	53		1500			122	44	23.5	12
	6-27	Grab	9:00 A	29	7.5	--	--	--	--		> 1100						
Average				29.3	8.7	1.5	--	40.75	34.5	(Median)	1500			122.7	77	12.16	12.1
Maximum				32	11.4	3.0	8.0	52.5	53		4300			158	120	23.5	44.
Minimum				25	6.4	0.7	7.2	17.0	27		230			78	44	5.5	0

* All bacteriological samples are grab samples.

Table 6

Tabulation of Individual Results and Summaries of Results (Minters Creek)

Sta.	Date	Type of Sample	Time	Temp. (°C)	D. O. (ppm)	B.O.D. (ppm)	pH	Alk. Total (ppm)	Color (ppm)	*Coliform Organisms MPN/100 ml			Solids (ppm)				
										Left	Center	Right	Settle-able	Total	Total Fixed	Susp.	Susp. Fixed
4	6-17	Grab	11:00 A)	32	6.8	17	8.0	72.0	28		2,300,000		800	280	190	72	36
		Grab	3:50 P)	31	6.7												
		Comp.															
	6-19	Grab	9:00 A	29	6.1	3.9	7.5	59.5	37		1,500,000			230	166	26	6
		Grab	2:30 P	32	10.1												
	6-20	Grab	8:45 A	--	--	3.2	7.4	55.5	35		730,000			196	100	62	46
		Grab	11:15 A	--	8.5												
	6-21	Grab	8:10 A	28	5.4												
		Grab	11:30 A	--	9.4									174	79	6.5	1.5
		Grab	4:10 P	32	9.5		7.9	57.0	34		930,000			160	83	8	3
		**Comp.	(11A - 4:30P)	--	--	4.0	--	--	--		4,300,000						
	6-22	Comp.	(DO 10:30A)	29	6.0	7.5	7.7	62.0	25		2,300,000			148	101	16	10
	6-23	**Comp.	(DO 9:00 A)	--	5.6	9.0	7.4	62.0	20		1,500,000			181	113	12.5	9.5
			(4:00P - 9:00A)														
	6-24	Grab	8:50 A	28	6.7	0.6	7.5	40.0	48		230,000			137	99	45	34
	6-25	**Comp.	(DO 9:15A)	28	7.8	5.2	7.5	51.0	25		91,000			177	160	--	6
	6-26	Grab	7:40 A	25	5.8	1.8	7.3	34.5	41		140,000			213	135	42.5	26.5
	6-27	**Comp.	(DO 8:30A)	29	5.9	--	7.5	41.5	29		93,000			--	--	26.5	14.5
Average				29.4	7.2	5.5	--	53.5	32.2	(Median)	930,000		800	189.6	122.6	31.7	17.1
Maximum				32.	10.1	17.0	8.0	72.0	48		4,300,000			280	190	72.0	46.0
Minimum				25	5.8	0.6	7.3	34.5	20		91,000			137	79	6.5	1.5

* All bacteriological samples are grab samples

** Continuous composite by vacuum

9-6

Table 7

Tabulation of Individual Results and Summaries of Results (Minters Creek)

Sta.	Date	Type of Sample	Time	Temp. (°C)	D. O. (ppm)	B.O.D. (ppm)	pH	Alk. Total (ppm)	Color (ppm)	*Coliform Organisms MPN/100 ml Left	Center	Right	Solids (ppm) Settleable	Total	Total Fixed	Susp.	Susp. Fixed
5	6-17	Grab	10:30 A	30	4.0	2.7	7.6	56.8	--		<3,000		3,000	306	278	208	199
	6-19	Grab	11:55 A	30	2.9	1.6	6.9	74.5	31		750			362	304	30	12
	6-20	Grab	2:50 P	31	2.8	4.1	7.0	38.5	40		110,000			276	190	61	48
	6-21	Grab	12:27 P	30.5	5.8	2.8	7.8	54.0	25		2,300			277	203	27	13
	6-22	Grab	2:45 P	30	3.1	5.7	7.2	63.5	37		4,300			300	243	31	18
	6-23	Grab	9:15 A	29.5	1.4	2.8	7.1	75.5	31		9,300			324	236	16.5	10.5
	6-24	Grab	10:40 A	29	2.0	1.9	7.4	65.0	38		15,000			239	191	37	27
	6-25	Grab	10:00 A	28.5	2.0	1.4	7.2	39.0	37		9,300			127	117	28	25
	6-26	Grab	10:00 A	28	2.1	2.5	7.1	35.0	37		9,300			167	99	44.5	36
	6-27	Grab	11:35 A	30	1.8	--	7.0	47.0	27		2,300			--	--	34	19.5
Average				29.7	2.8	2.8	--	54.9	33.7	(Median)	9,300		3,000	264.2	206.3	51.7	40.8
Maximum				31	5.8	5.7	7.8	75.5	40		110,000			362	304	208	199
Minimum				28	1.4	1.4	6.9	35.0	25		750			127	99	16.5	10.5

* All bacteriological samples are grab samples

Table 8

Tabulation of Individual Results and
Summaries of Results (Black Warrior River)

Sta.	Date	Type of Sample	Time	Temp. (°C)	D. O. (ppm)	B.O.D. (ppm)	pH	Alk. Total (ppm)	Color (ppm)	*Coliform Organisms MPN/100 ml			Solids (ppm)				
										Left	Center	Right	Settle-able	Total	Total Fixed	Susp.	Susp. Fixed
6	6-17	Grab, left side		30	7.3												
		Grab, center		30	7.4	1.4	7.6	34.5	9	930	930	2300	750	136	96	32	28
		Grab, right		30	7.4												
		Comp.															
	6-19	Grab	11:45 A	30	8.1	2.3	7.5	36.0	9		< 30			202	148	44	28
	6-20	Grab	2:40 P	31	8.0	3.2	7.9	38.5	13	36	430	360		157	105	19	13
	6-21	Grab	12:20 P	--	8.8	1.6	7.7	32.0	7		91						
	6-22	Grab	2:35 P	30	7.7	--	--	--	--	72	210	230					
	6-24	Grab	10:30 A	30	6.8	1.4	7.1	22.5	9	930	2400	930		134	106	33.5	24.5
	6-27	Grab	11:00 A	30	7.2	--	7.3	24.0	9					--	--	31.5	20.5
Average				30.1	7.6	2.00	--	31.16	9.3	930 (Median)	430	930	750	157.2	113.7	32.0	22.8
Maximum				31	8.8	3.2	7.9	38.5	13	930	2400	2300		202	148	44	28
Minimum				30	6.8	1.4	7.1	22.5	7	36	91	230		134	96	19	20.5

* All bacteriological samples are grab samples.

Table 9

Tabulation of Individual Results and
Summaries of Results (Black Warrior River)

Sta.	Date	Type of Sample	Time	Temp. (°C)	D. O. (ppm)	B.O.D. (ppm)	pH	Alk. Total (ppm)	Color (ppm)	*Coliform Organisms MPN/100 ml			Solids (ppm)				
										Left	Center	Right	Settle-able	Total	Total Fixed	Susp.	Susp. Fixed
7	6-17	Grab left side		30	7.6	1.9	7.6	38.0	9	23,000	1,500	9,300					
		Grab, center		30	7.2								1,500	128	94	46	34
		Grab, right side		30	7.3												
		Comp.															
	6-19	Grab	12:05 P	30	7.8	1.4	7.2	36.0	8		730			182	148	23	17
	6-20	Grab	3:00 P	31	9.8	2.8	7.5	37.0	15	<300	230	<300		156	104	17.5	11.5
	6-21	Grab	12:30 P	30.5	8.6	1.7	7.7	35.0	7		430						
	6-22	Grab	2:55 P	30	7.3	--	--	--	--	<300	430	620					
	6-24	Grab	10:35 A	30	6.9	1.2	7.5	25.0	3	930	430	930		131	104	45.5	31.5
	6-27	Grab	11:40 A	30	7.2	--	7.1	26.0	7	4,600	430	430		--	--	38.5	25
Average				30.2	7.7	1.8	--	32.8	8.2	930 (Median)	430	620	1,500	149.2	112.5	34.1	23.8
Maximum				31	9.8	2.8	7.7	38	15	23,000	1,500	9,300	--	182	148	46	34
Minimum				30	6.9	1.2	7.1	25	3	<300	230	<300	--	128	94	17.5	11.5

* All bacteriological samples are grab samples.

Table 10

Tabulation of Individual Results and
Summaries of Results (Black Warrior River)

Sta.	Date	Type of Sample	Time	Temp. (°C)	D. O. (ppm)	B.O.D. (ppm)	pH	Alk. Total (ppm)	Color (ppm)	*Coliform Organisms MPN/100 ml			Solids (ppm)				
										Left	Center	Right	Settle-able	Total	Total Fixed	Susp.	Susp. Fixed
8	6-17	Grab, left side		30	7.4												
		Grab, center		30	7.2	1.7	7.4	36.0	6		2,300		Negative	127	85	23	18
		Grab, right side		30	7.2												
		Comp.															
	6-19	Grab	12:45 P	30	8.2	1.5	7.6	36.0	9		36			190	160	31	21
	6-20	Grab	3:25 P	31	--	2.2	7.5	40.0	12		230			153	104	16.5	9
	6-21	Grab	12:48 P	30.5	8.5	1.6	7.7	30.0	--		4,300						
	6-22	Grab	3:30 P	--	7.6	--	--	--	--	430	91	91					
	6-24	Grab	9:55 A	30	7.4	1.3	7.4	24.0	1	2,400	430	230		93	68	19	10.5
	6-27	Grab	12:00 A	--	7.2	--	7.3	25.5	--		1,500			--	--	33.5	24
Average				30.2	7.6	1.7	--	31.8	6.5	Median--	430	--	Negative	140.6	104.2	24.6	16.4
Maximum				31	8.5	2.2	7.7	40	12	2,400	4,300	230		190	160	33.5	18
Minimum				30	7.2	1.3	7.3	24	1	430	36	91		93	68	16.5	9

* All bacteriological Samples Are Grab Samples

Table 11

Tabulation of Individual Results and
Summaries of Results (Black Warrior River)

Sta.	Date	Type of Sample	Time	Temp (°C)	D. O. (ppm)	B.O.D. (ppm)	pH	Alk. Total (ppm)	Color (ppm)	*Coliform Organisms MPN/100 ml Left	Center	Right	Solids (ppm) Settle-able	Total	Total Fixed	Susp.	Susp. Fixed
9	6-18	Grab	9:30 A	30.5	8.3	--	--	--	--		910						
	6-21	Grab	11:00 A	30.5	6.4	--	--	--	--		2,300						
	6-23	Grab	10:00 A	30	7.0	--	--	--	--	150	75	93	- - - - NO SOLIDS - - - -				
	6-24	Grab	9:40 A	30	7.1	--	--	--	--	75	93	230	- - ANALYSES PERFORMED - -				
	6-25	Grab	9:20 A	29.5	7.4	--	---	--	--	230	230	430					
Average				30.1	7.2					150	230	230					
										Median							
Maximum				30.5	8.3					230	2,300	430					
Minimum				29.5	6.4					75	75	93					

* All Bacteriological Samples Are Grab Samples

Table 12

Tabulation of Individual Results and
Summaries of Results (Black Warrior River)

Sta.	Date	Type of Sample	Time	Temp. (°C)	D. O. (ppm)	B.O.D. (ppm)	pH	Alk. Total (ppm)	Color (ppm)	*Coliform Organisms MPN/100 ml Left	Center	Right	Solids (ppm) Settle-able	Total	Total Fixed	Susp.	Susp. Fixed
10	6-18	Grab	9:30 A	30.5	8.3	--	--	--	--		360						
	6-23	Grab	10:10 A	30	7.6	--	--	--	--	230	93	93	- - - - - NO SOLIDS - - - - -				
													- - - ANALYSES PERFORMED - - -				

*All Bacteriological Samples Are Grab Samples

Table 13

Tabulation of Individual Results and
Summaries of Results (Black Warrior River)

Sta.	Date	Type of Sample	Time	Temp (°C)	D. O. (ppm)	B.O.D. (ppm)	pH	Alk. Total (ppm)	Color (ppm)	*Coliform Organisms MPN/100 ml			Solids (ppm)				
										Left	Center	Right	Settle-able	Total	Total Fixed	Susp.	Susp. Fixed
12	6-18	Grab	5:20 P	31	7.2	--	--	--	--	<300							
	6-20									91			---- NO SOLIDS ----				
	6-25	Grab	3:35 P	30	4.7	--	--	--	--	4,600			-- ANALYSES PERFORMED --				

7-M

* All Bacteriological Samples Are Grab Samples

Table 14

Tabulation of Individual Results and
Summaries of Results (Black Warrior River)

Sta.	Date	Type of Sample	Time	Temp (°C)	D. O. (ppm)	B.O.D. (ppm)	pH	Alk. Total (ppm)	Color (ppm)	*Coliform Organisms MPN/100 ml			Solids (ppm)				
										Left	Center	Right	Settle-able	Total	Total Fixed	Susp.	Susp. Fixed
13	6-18	Grab	4:50 P	30	7.6	--	--	--	--	910							
	6-25	Grab	3:00 P	30	5.6	--	--	--	--	2,400			- - - - NO SOLIDS - - - - - - ANALYSES PERFORMED - -				

N-4

* All Bacteriological Samples Are Grab Samples

Standard precautions were used in collecting samples and in preserving samples until the laboratory determinations were performed. The bacteriological examinations and chemical analyses were made in accordance with "Standard Methods for the Examination of Water and Sewage," Tenth Edition, of the American Public Health Association and the American Water Works Association

Present use of water resources of Minters Creek and the Black Warrior River in the vicinity of Eutaw, Alabama are listed below:

1. Water Supply No known use is made of the waters of Minters Creek or the Black Warrior River as a source of potable water supply.
2. Bathing and Swimming Use is made of Minters Creek for swimming, upstream from the source of pollution. No swimming was observed in the Black Warrior River.
3. Fishing Fishing activity was observed all along the Black Warrior River. Fish were observed in Minters Creek but no fishermen were seen.
4. Wildlife A beaver pond was observed on the Minters Creek watershed. Hunting was reported to be a major use of the wooded area.
5. Recreation Many small craft and boating activities were observed on the Black Warrior River.
6. Transportation The Black Warrior River is canalized from its mouth to the vicinity of Birmingham, Alabama by nine low-lift and two high-lift lock and dam structures.

7. Industrial Water Supply No known use is made of waters from Minters Creek or the Black Warrior River in the vicinity of Eutaw, Alabama.

8. Waste Disposal North of the survey area, about 70 river miles, the City of Tuscaloosa, 1950 population 46,396, presently discharges its untreated sewage into the Black Warrior River. A primary sewage treatment plant is now under construction in Tuscaloosa. The town of Eutaw, 1950 population 2,348, discharges untreated sewage from about 800 of its population into Minters Creek.

Pollution conditions, as seen by a biologist from the Robert A. Taft Sanitary Engineering Center, are recorded in the following paragraphs. These observations were made during a field trip to the surveyed area on June 25-27, 1957.

At the upper end of the pool impounded by the V-notch weir at Station 2, settleable solids under the sewer outfall were piled above the water surface. The following conditions were noted within the pool.

a. Marginal blue-green algal mats.

b. Ebullition lifts algal mats and sludge from bottom and carries them through pool over V-notch weir. Sewage solids have blue-green algae fixed to them.

c. Mosquito wigglers marginal in this pool.

d. Water beetles and backswimmers.

e. Black sludge observed through pool marginally.

f. Ebullition of sewage gases throughout pool.

g. Sludge one foot in thickness immediately behind the V-notch weir.

h. Strong sewage odor.

Below Station 2, the following observations were made:

a. Sludge eight to ten inches in thickness immediately below V-notch weir.

b. Blood worms.

c. Schools of minnows swam at surface under V-notch weir and at weir shoulders. (Ten minnows in largest school.)

d. Blue-green algae marginal; no mats.

e. Sewage odor.

In the vicinity of Station 3, in Minters Creek, the following observations were made:

a. Water with silt; light brown turbidity.

b. Bottom deposits sandy.

c. Schools of minnows. (Twenty in largest school.)

d. Schools of small sunfish. (Five in largest school.)

e. Water beetles and backswimmers.

f. Green algae material.

In Minters Creek and in the pool created by the rectangular weir at Station 4, the following observations were made:

a. Floating sewage solids with attached blue-green algae move through this pool from V-notch weir pool; four algal mats behind rectangular weir.

b. Bottom deposits behind weir; fine sand.

c. Slight sewage odor from right bank deposits; none from left bank deposits. High water earlier in week apparently flushed most sludge from this pool.

d. Minnow schools and water beetles behind weir. (Five to fifteen in minnow schools.)

e. Water with light brown turbidity.

In Minters Creek, and immediately downstream from Station 4, the following observations were made:

a. Minnow schools (3). Fifteen in the largest.

b. Water beetles and backswimmers.

c. Bottom deposits of fine sand mixed with organic sludge; no distinct sludge deposits.

d. Slight sewage odor.

e. Riffle rocks downstream from rectangular weir represent a potential trickling filter, however, zoogleal films are absent. This is an area for reaeration.

Downstream fifty feet from Station 4, the following observations were made:

a. Sewage sludge $\frac{1}{2}$ inch thick over sand on left bank; sand on right bank.

b. Sewage odor and hydrogen sulfide.

c. Green algae covering sludge.

d. Schools of minnows, sunfish, water beetles and backswimmers.

The above conditions prevail downstream 250 feet.

Downstream about 350 feet from Station 4, the following observations were made:

a. Sewage sludge $\frac{1}{2}$ inch thick over entire bottom.

b. Blood worms.

c. Schools of minnows.

d. About 25 feet below this point, an oily sheen was very noticeable.

Downstream about 1,400 feet from the rectangular weir (Station 4), the following observations were made:

a. Five sludge worms in one square foot of bottom scrapings in crevices in sand that are filled in by natural organics such as leaf mold and black humus.

b. No evidence of sewage solids on stream bottom; bottom of fine sand.

c. No sewage odor.

d. Fine film of black sewage sludge, 2-3 mm in thickness deposited over sand bar from last high water; sand bar out of water at that time.

e. Water clear through maximum depth of two feet.

Minters Creek was observed from the banks at points roughly estimated at one-half, one, one and one-half, and two mile points. It was impossible to exactly locate points from existing maps due to meandering of stream.

a. Bank observations indicated water to be clear.

b. Green marginal algae present.

c. At the two mile point, Minters Creek contained an algal bloom covering surface water for 100 yards; this bloom appeared to have blown in from the Black Warrior River and was concentrated in the mouth of Minters Creek.

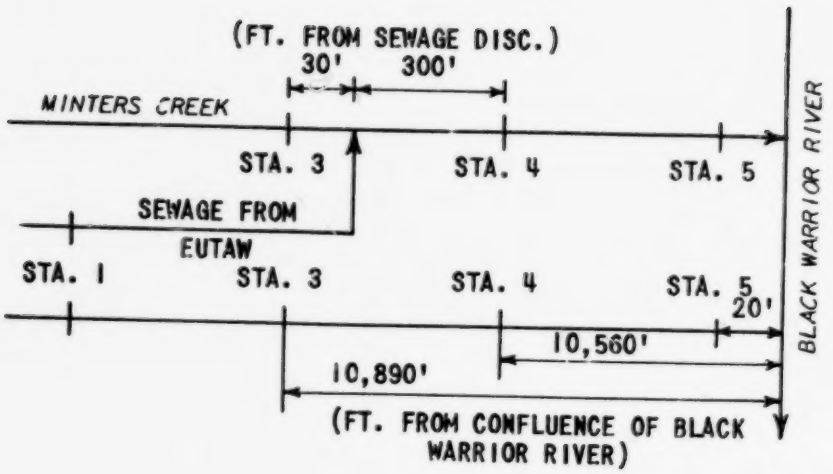
On the Black Warrior River, at the confluence of Minters Creek, and 25 feet downstream from Minters Creek, the river bottom was composed of clean white sand. In addition, at the confluence, compact and loose clay was present. Downstream at Station 8, the river bottom consisted of clean fine sand.

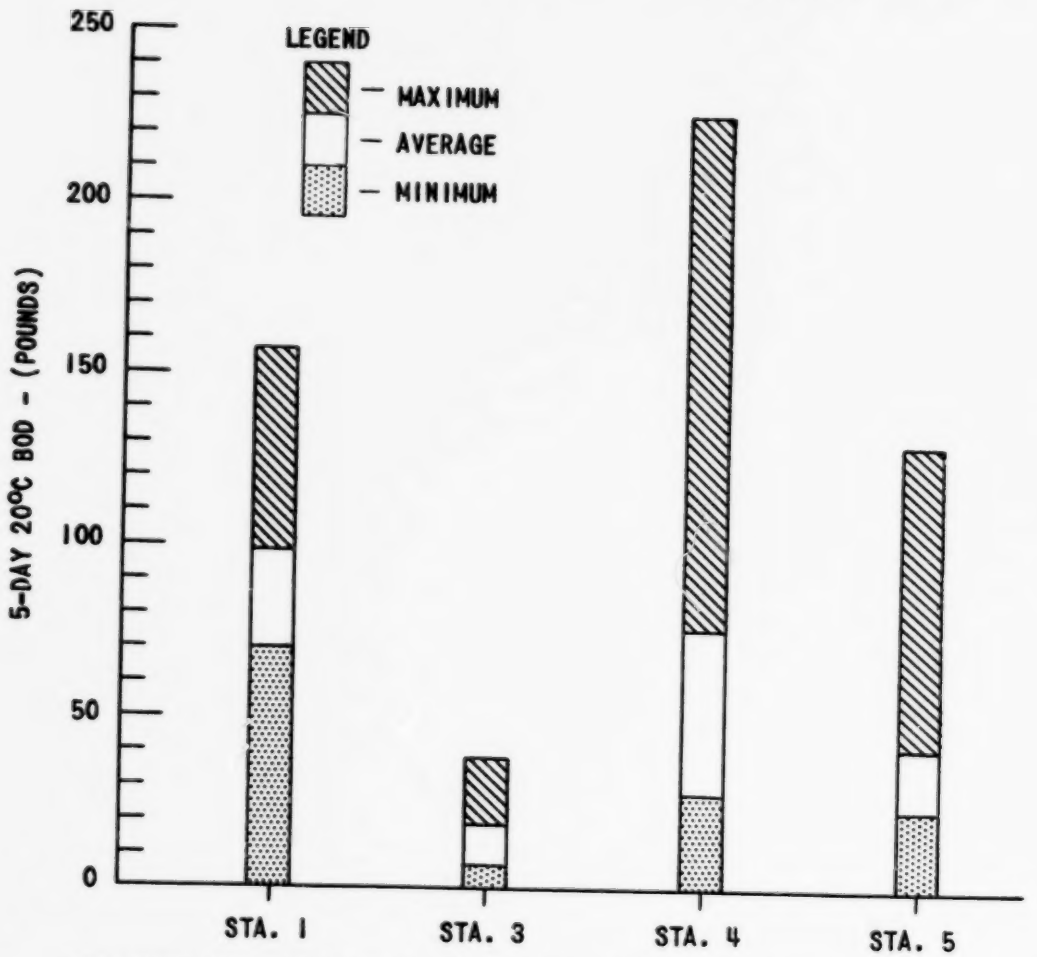
Sludge deposits, blue-green algal mats and insect nuisances were confined within the [illegible] extending from the sewer outfall to about 1,400 feet downstream from Station 4.

DISCUSSION

The pollution load from Eutaw was somewhat lighter than would be expected from a contributing population of 800. The 5-day 20° C. B.O.D. ranged from 70 to 157 pounds per day and averaged 98 pounds per day. The suspended solids ranged from 55 to 174 pounds per day and averaged 99 pounds per day. The pollution loads expected, based on averages from previous experience, would be closer to the maximum loads observed.

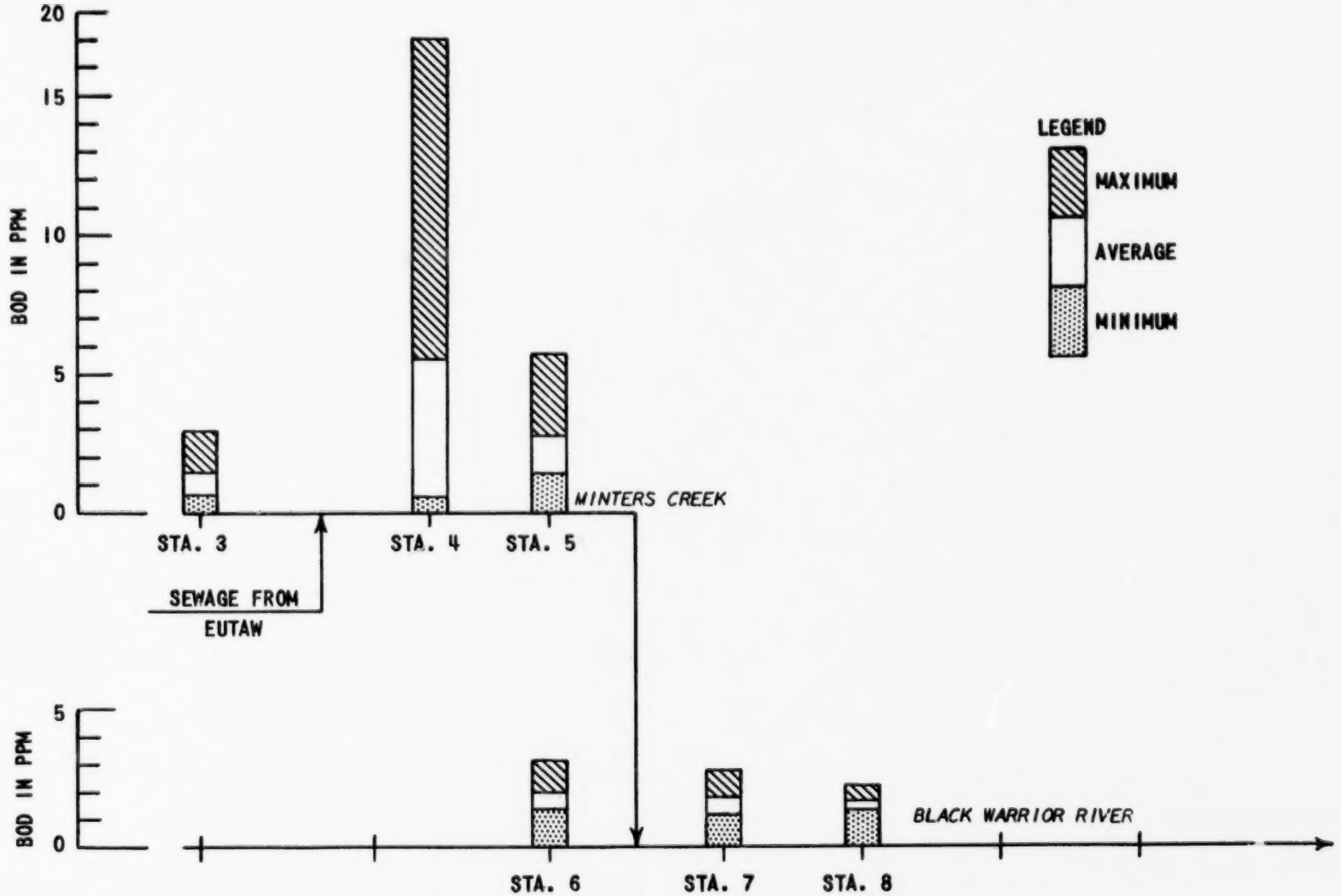
The effect of the pollution load on Minters Creek is clearly shown in Figures 2, 3, 4, 5, and 6. Several of the figures will be separately discussed. It should be pointed out that unnatural conditions were caused by ponding in order to determine continuous flows. It is believed that while conditions observed at Station 4 will not occur naturally, the conditions observed at Station 5 will be those occurring naturally. The ponding, and resulting settling, which was induced artificially, also occurred in natural pools further downstream. That observation is substantiated in that time of passage through the pool at Station 4 averaged .3 feet per second; while the time of passage from Station 4 to the mouth of Minters Creek was something less than the .3 feet per second. High flows which occurred during the study, resuspended the settled material and flushed it downstream. It is believed that if emphasis is placed on differences between loads at Stations 3 and 5, a clearer picture will be obtained as to the effect of the town of Eutaw's sewage on the Black Warrior River.





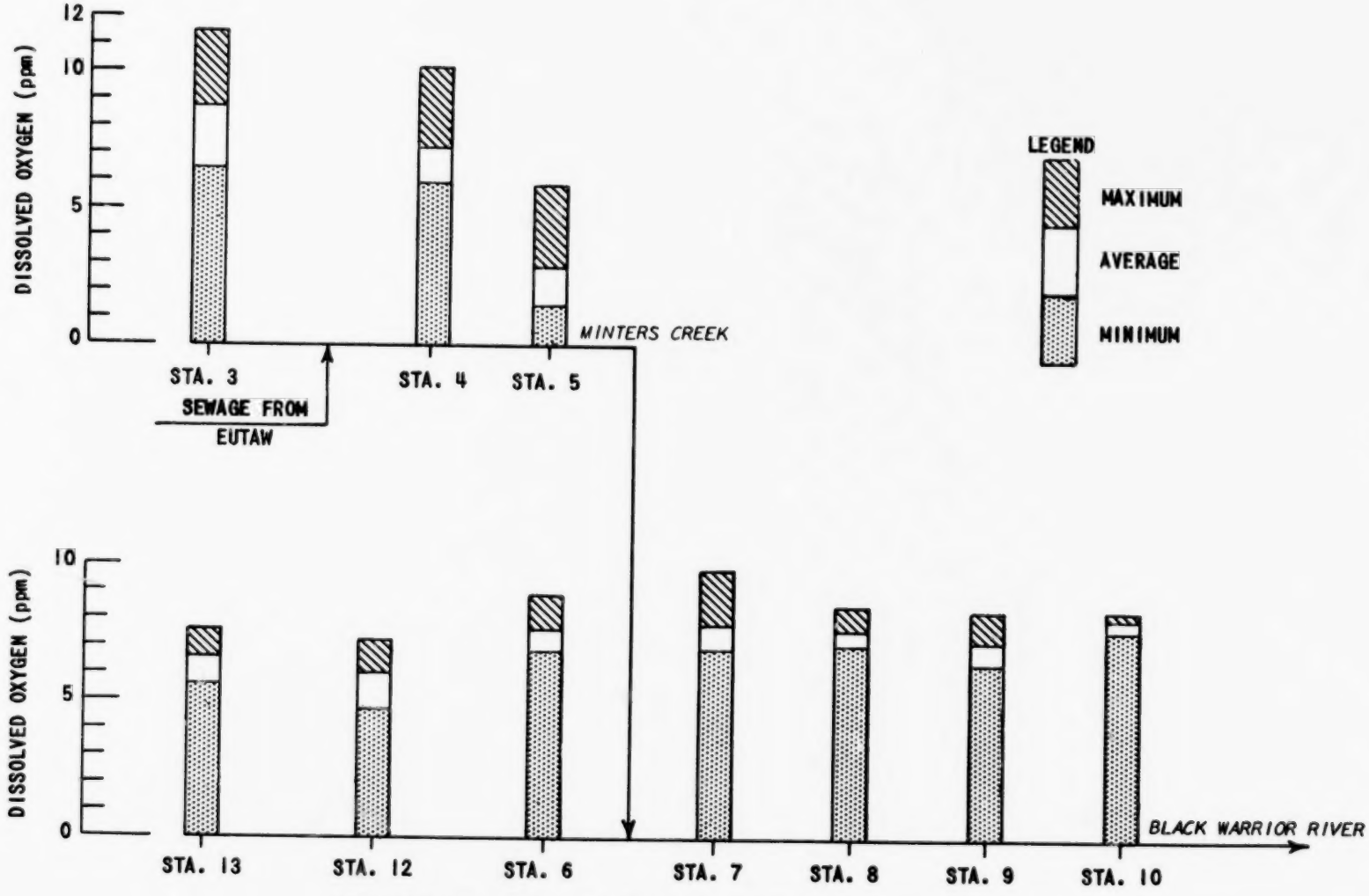
SUMMARY OF DATA 5-DAY 20°C BOD (POUNDS) DAY VS. DISTANCE

FIGURE 2



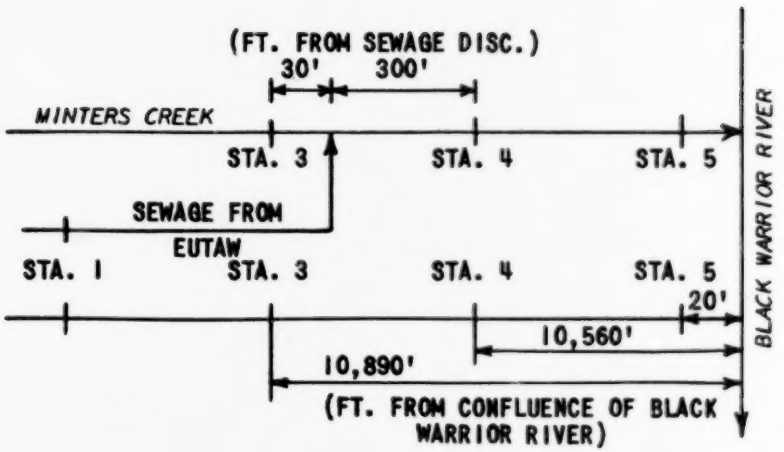
SUMMARY OF DATA BOD (5-DAY, 20°C) IN PPM VS. DISTANCE

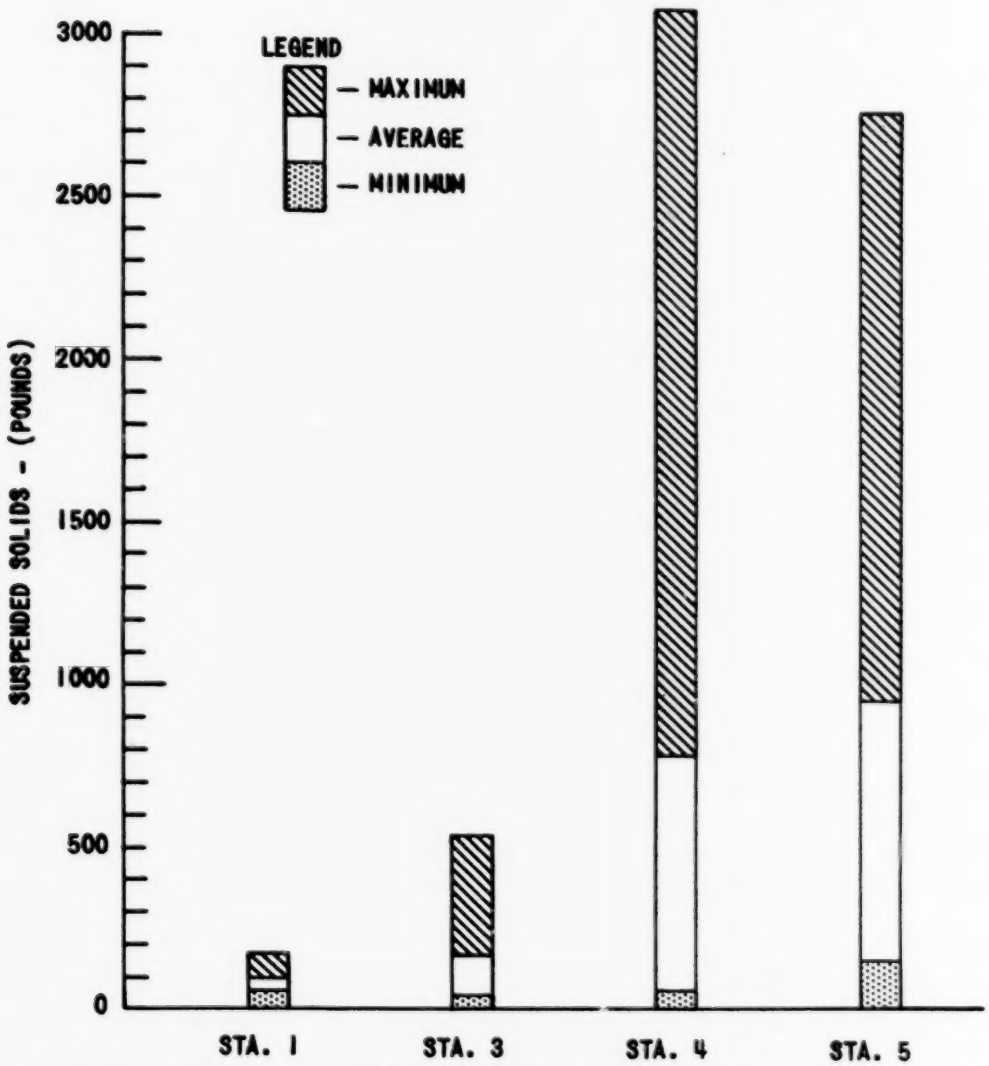
FIGURE 3



SUMMARY OF DATA - DISSOLVED OXYGEN (ppm) VS. DISTANCE

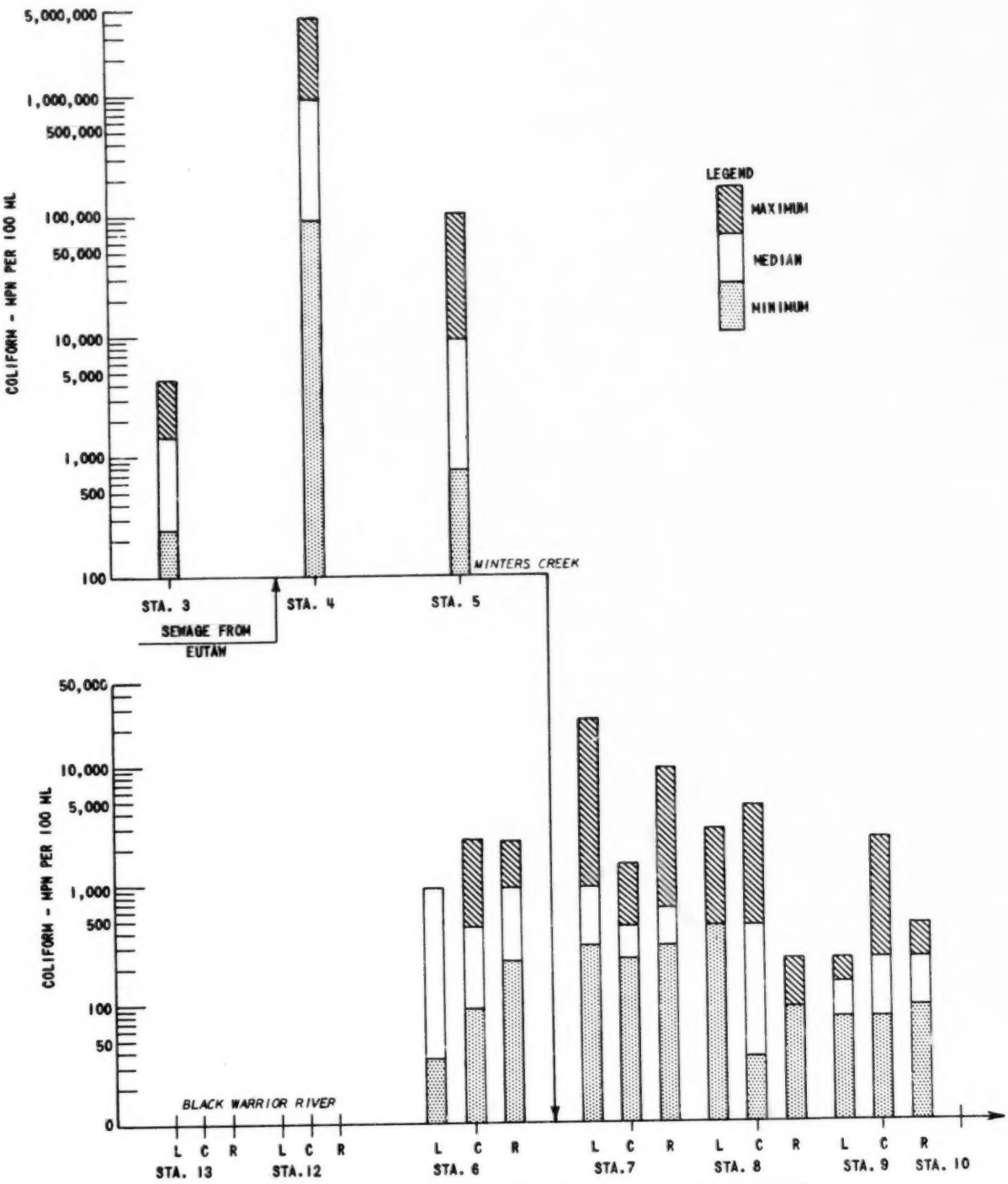
FIGURE 4





SUMMARY OF DATA SUSPENDED SOLIDS (POUNDS) DAY VS. DISTANCE

FIGURE 5



SUMMARY OF DATA COLIFORM MPN PER 100 ml. VS. DISTANCE

FIGURE 6

The daily 5-day 20°C BOD load on Minters Creek increased from an average of 19 pounds upstream from the discharge of sewage (Station 3) to an average of 42 pounds at the confluence of the Black Warrior River (Station 5). This is an increase of only 23 pounds while the average load from Eutaw was 98 pounds.

A load of 23 pounds of 5-day 20°C BOD would be insignificant in a flow of 300 cfs in the Black Warrior River. By computation, the 23 pounds would increase the 5-day 20°C BOD load by less than .02 ppm, while the maximum observed 5-day 20°C BOD load of 157 pounds at Station 1 would only increase the concentration of BOD by .1 ppm.

The effect of the pollution load on the oxygen resources of Minters Creek has been computed by comparing pounds of dissolved oxygen in Minters Creek at Station 3 and Station 5 (Table 15). It can be seen that on the average, there was a daily loss of 68 pounds of dissolved oxygen over the two mile reach studied, while the maximum daily loss was 134 pounds and the minimum daily loss was 34 pounds.

As observed on the River at Stations 6 and 7 (Figures 3 and 4) and with flows recorded during the survey (Table 2), the downstream Station 7 had less 5-day 20°C BOD and more dissolved oxygen than upstream Station 6, indicating no measurable influence by Minters Creek pollution loads on the oxygen resources of the Black Warrior River.

The pollution load in Minters Creek had no effect on the oxygen

Table 15

Loss of Oxygen (Pounds) in Minters Creek

Date 1957	Station 3 Q (CFS)	Station 3 D.O. ppm	Station 3 D.O. pounds	Station 5 D.O. ppm	Station 5 D.O. pounds	Δ D.O. pounds
6-17	2.46	8.5	112	4.0	53	-58
6-20	1.64	9.6	85	2.8	25	-60
6-21	1.64	9.6	85	5.8	51	-34
6-22	1.64	8 0	71	3.1	27	-44
6-23	1.64	7.5	66	1.4	12	-54
6-25	4.26	7.8	180	2.0	46	-134
6-26	4.20	6.4	145	2.1	48	-97
Average						-68
Maximum						-134
Minimum						-34

resources of the Black Warrior River.

Data indicated that daily suspended solids contributed by sewage from Eutaw ranged from 55 pounds to 175 pounds and averaged 99 pounds (see Figure 5). The daily suspended solids load in Minters Creek at Station 3 above the source of pollution ranged from 31 to 531 pounds and averaged 169. At Station 4, just 100 yards downstream from the entrance of sewage, the daily suspended solids ranged from 57 to 3,070 pounds and averaged 777 pounds. Within this short reach, the solids from Station 1 plus those from Station 3 should equal the solids observed at Station 4. Daily tabulations are shown below in Table 16. Table 16 shows that about 40% of the solids from Station 1 are deposited before discharge of liquid from Station 2. These solids are resuspended and swept out by fluctuating flows in unnamed branch. This must account for the large differences between sums at Stations 1 plus 3 and Station 4.

Between Stations 4 and 5, it can be seen that in five of six observations, there was no settling of suspended solids. In only one case was settling observed between Stations 4 and 5 but unfortunately, on that date, no observation was made on Station 3. Also, on that date (June 24) there was an unusually high flow in Minters Creek (3 to 6 times other observed flows).

Again comparing data between Stations 3 and 4, it can be seen that suspended solids contributed daily by Eutaw sewage ranged from 0 pounds to 881 pounds. Between Stations 4 and 5, the increase of

TABLE 16

Increase of Suspended Solids to Black Warrior River

Date (1957)	Suspended Solids in Pounds								
	Sta. 1	Sta. 2	Sta. 3	Sta. 1+3	Sta. 4	Δ Sta. 4-(3+1)	Sta. 5	Sta. (5-4)	Sta. 4-3
6 - 17	174	94	72	246	953	+ 707	2,750	+ 1,797	+ 881
6 - 19	129	60	276	405	384	- 19	436	+ 52	+ 108
6 - 21	94	67	79	173	57	- 116	238	+ 181	-0-
6 - 22	80	77	150	230	141	- 89	274	+ 133	-0-
6 - 23	55	23	46	101	110	+ 9	141	+ 31	+ 64
6 - 24					3070		2,530	- 540	Unknown

suspended solids discharged daily to the Black Warrior River ranged from 31 pounds to 1,797 pounds. It is not known whether additional suspended solids were added to the stream between Stations 4 and 5 by clearing activities or whether previously deposited solids were re-suspended. As no settling of suspended solids was indicated between Stations 4 and 5, it is probable that suspended solids loads from Eutaw sewage to the Black Warrior River ranged from zero to 881 pounds daily.

With a flow of 300 cfs in the Black Warrior River, 881 pounds would only be about .5 ppm. As suspended solids was shown to increase between Station 6 and 8 by about 2 ppm, solids from Minters Creek do have a slight but measurable effect on the Black Warrior River at low flows.

The effect of bacterial pollution on Minters Creek and the Black Warrior River from Eutaw sewage is shown on Figure 6 . On Minters Creek above the source of pollution at Station 3 the median coliform MPN was 1,500 per 100 ml, and the maximum was 4,300 per 100 ml while downstream at Station 5, the median coliform MPN was 9,300 per 100 ml and the maximum was 110,000 per 100 ml. Immediately downstream from the source of pollution, Station 4, the median MPN was 930,000 per 100 ml and the maximum was 4,300,000 per 100 ml. Good recovery was indicated in Minters Creek.

Minters Creek enters the Black Warrior River on the left side looking upstream. The maximum coliform MPN at Station 6, a quarter of

a mile upstream from Minters Creek, was 930 per 100 ml at the left quarter point, while at Station 7, a quarter of a mile downstream from Minters Creek, the maximum coliform was 23,000 at the left quarter point. The median coliform was unchanged. The data indicates only a moderate bacterial influence of Eutaw sewage on the Black Warrior River.

The data all indicate that Eutaw sewage has only a slight effect on the Black Warrior River under survey conditions of June 10-24, 1957. With the new lock and dam in operation, causing a deeper impoundment, it is probably that the Eutaw sewage would have no measurable effect on the Black Warrior River because Minters Creek embayment would act similar to a stabilization pond.

However, the impoundment will back water into the outfall sewer to about Manhole 10. Under the impoundment conditions, it is believed that the sewage would become septic within the sewer, causing odors to rise through manholes along the line of the sewer, and causing solids to deposit within the pipe, and restricting movement of sewage.

A new outfall could be made by breaking into the sewer somewhere above Manhole 10, and permitting sewage to discharge freely into the backwater. The situation created would be undesirable as there would be little, if any, dilution water available thereby differing materially from the intended present situation. The sewage would become septic, creating odor nuisances. Other nuisances and health hazards created would probably be as follows:

1. Sludge deposits would form and become obnoxious.
2. Floating solids would be unsightly.

3. Mosquito populations should thrive in water enriched with organics from domestic sewage.
4. Blue-green algae mats might develop in the outfall area. Winds concentrating the mats on banks will make such banks unsuitable for boat launching, fishing, or recreational areas. Decay of the gelatinous blue-green algae in water and on the banks would cause offensive odors.
5. High coliform MPN values incompatible with recreational uses would probably prevail.

It should be pointed out that if the reservoir area at the possible outfall near Manhole 10 is remote because of dense timber, or because of shallowness not permitting boating, lack of human contact with this area will, of course, not make the above nuisances a reality to human concern except for mosquitoes. Occasional local heavy rains will tend to flush the sewage into the deeper and more usable embayment. At the time of the survey, no habitation was observed in the vicinity of the area of discharge.

The Alabama State Department of Health believes that the Minters Creek embayment will be a recreational area. Conditions as above described will cause much complaint from users of the proposed recreational area.

The construction of a new outfall near Manhole 10 is not a good solution to the problem and is not equivalent to the present situation. When originally built, the outfall sewer discharged directly into a

flowing stream and the sewage was both assimilated and carried from this area. Later, when the sewer was broken, about 1,900 feet from Minters Creek, sewage solids were deposited along the unnamed branch causing local odors. This situation was not satisfactory, but because there was limited use of the area, there were no complaints. The intended purpose of the outfall sewer was to discharge untreated sewage directly into flowing waters of Minters Creek.

There are two other solutions more desirable than creating an outfall near Manhole 10.

One solution would be to abandon the entire length of the outfall sewer from about the fourth manhole east of highway 11 (about Manhole 21), discharging the sewage into a treatment plant. The effluent from the treatment plant could flow through the outfall sewer to the present outfall (which will then be submerged) or from the vicinity of existing Manhole 10 through a new outfall into the embayment.

A second solution would be to abandon the entire outfall sewer and substitute a lift station and force main to carry the raw sewage over the forty to fifty feet high ridge and discharge it into the proposed trunk sewer leading to a proposed stabilization pond in the Watson Creek drainage area.